Conservation of prey long forest complex, Cambodia

conservation, environmental services and sustainable use

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CONSERVATION OF PREY LONG FOREST COMPLEX, CAMBODIA

CONSERVATION, ENVIRONMENTAL SERVICES AND SUSTAINABLE USE

WORKING PAPER MAY 2010

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PREFACE

Forest and Landscape, Denmark and Danida have had long term cooperation with the Forest Administration (FA) of Cambodia on forest and environmental protection. The focal areas for all cooperation have been sustainable development, protection of sensitive areas and conservation of genetic resources of selected tree species. During the many years of cooperation we have witnessed a steady development in economy and livelihood, but unfortunately also a steady decline in forest resources.

This project on Prey Long started in 2007 with a joint field expedition by Forest Administration, Forest and Landscape Denmark FLD) and Conservation International, Cambodia (CI). The result of that trip is published in the document 'A floral and faunal biodiversity assessment of Prey Long'. Further botanical surveys were conducted in the northern part of Prey Long with focus on the rare swamp forests in April 2008 and 2009. The objectives of these studies were to characterize the swamp forests and assess their conservation status.

This report contains a summary of findings from the three expeditions. It identifies areas of conservation concern and outlines important elements for a conservation strategy for Prey Long.

We hope that this document will draw attention to one of the last intact lowland rainforests of Indochina and the urgent need to develop a strategy for its continued protection, provision of environmental services and sustainable management.

CONTENT

CLIMATE CHANGE AND THE PREY LONG FOREST PROJECT

Emissions from deforestation and forest degradation in developing countries constitute some 20% of the total emissions of greenhouse gases annually. If we are to be serious in our efforts to combat climate change, reducing emissions from deforestation and forest degradation (REDD) in developing countries must be addressed.

REDD projects has the potential to generate substantial benefits in addition to the reduction of greenhouse gas emissions. These include positive impacts on biodiversity and sustainable development, including poverty reduction and strengthening indigenous people's rights. The proposed REDD project seeks to provide the financial means to manage and conserve the last intact vestige of lowland rainforest in Cambodia. In doing so, the project aims to produce a triple dividend – gains for the climate, for biodiversity and for sustainable development in Cambodia.

PREY LONG - ECOLOGICAL IMPORTANCE AND CONSERVATION STATUS

Prey Long is the largest lowland evergreen forest in Cambodia, and probably in the Indo-Burma Hotspot[1]. Although Cambodia has a system of protected areas it reveals a clear lack of protection for wet lowland evergreen forest. Protected areas are presently located in mountainous regions where floral and faunal species often differ markedly from lowland habitats. This lack of representation of lowland evergreen forest in national protected area system is found across the Indo-Burmese hotspot. Consequently, the central lowland of Cambodia was identified as a critical ecosystem for the Indo-Burmese hotspot as it is the last intact vestige of Indochina's once widespread lowland evergreen forest (Birdlife International 2005, Appendix 1).

Lowland evergreen forests have historically been granted for logging concessions due to their ease of accessibility and their abundance of high value timber. As forest concession activities in Cambodia have declined in recent years, land grabbing and the potentially excessive use of economic land concessions (ELCs)[2] have emerged as major threats to forests and rural livelihoods. Though lowland forest was once the most common vegetation type in Cambodia, today it is poorly protected, highly threatened, and receives virtually no attention from researchers and conservationists.

The forests are gradually and continuously being reduced in size and quality due to illegal logging and agricultural encroachment into the area. The ongoing degradation causes an immediate threat to larger and endangered wildlife such as bears, banteng, gibbons, elephants, fishing cats, and several species of turtles. Continuous degradation will inevitably also reduce the diversity of smaller fauna (mammals, birds and reptiles) and flora.

[1] The Indo-Burma hotspot is one of the worlds' 25 biodiversity hotspots, which represent areas with exceptionally high biodiversity. The Indo-Burma hotspot encompasses more than 2mill km^2 covering Burma, Thailand, Laos, Cambodia, Vietnam, Southern China and part of the Indean West Bengal. www.biodiversityhotspots.org

[2] According to the Cambodian Government's Sub-decree 146 on Economic Land Concessions (ELCs), "Economic Land Concessions refers to a mechanism to grant private state land ... through a contract to a concessionaire to use for agricultural and industrial-agricultural exploitation". ELCs are generally large land areas (limited by the 2001 Land Law to 10,000 hectares though larger concessions were granted prior to the Land Law) up to a maximum period of 99 years. ELCs are distinct from *Forest Concessions* (for private management of forest areas for timber) or *Social Land Concessions* (distribution of plots up to 5 hectares to the landless and land poor for family residential and agricultural use).

The high ecological significance of Prey Long was highlighted as early as 1975 (McNeely 1975). More recently, it was included in a listing of tentative natural sites for World Heritage consideration for Cambodia (IUCN 2002). The importance of Prey Long for biodiversity conservation was reiterated by World Bank studies in 2004 and 2006. Prey Long forest is reportedly home to 80% of the most valuable and endangered indigenous tree species of Cambodia (CTSP/FA 2003). Furthermore, the area was identified as vital to the national reserve network by a group of national experts due to its importance for floral conservation (Strange et al. 2007). However, few surveys have been undertaken, and those that were conducted were mostly unsystematic and extremely limited in duration and taxonomic scope.

In order to assess the biological importance of the area and determine whether Prey Long should be a priority area for conservation, University of Copenhagen (KU), Conservation International (CI), and Forestry Administration (FA) began biological surveys of the area in 2007.

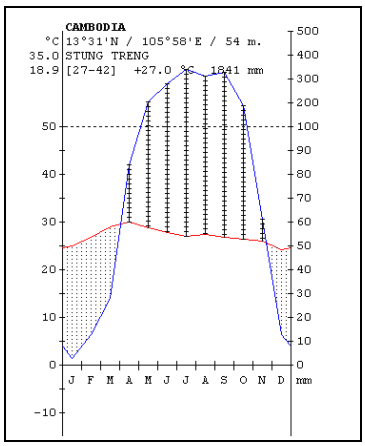

Fig. 1. Climate diagram of Stung Treng. The climate of Northern Cambodia is warm tropical climate with short dry season and excess precipitation during the rainy season.

PREY LONG FOREST AREA, JURISDICTION AND LOCAL LIVELIHOODS

Prey Long is situated to the west of Mekong River in the northern part of Cambodia and stretches over four provinces: Kratie, Kampong Thom, Steung Treng and Preah Vihear. (Fig 2 and Appendix 2). People in this region refer to this forest as Prey Long. These forests straddle various tributaries to the Mekong River, including the Siembok, O'Long, Chinit Rivers, and streams that feed the Steung Sen to the West, such as the Porong, O Kachong and O Ronul. The broadest definition of the Prey Long landscape covers about 520,000 ha. The most biologically important and most intact portion of Prey Long covers about 135,000 ha (Appendix 2).

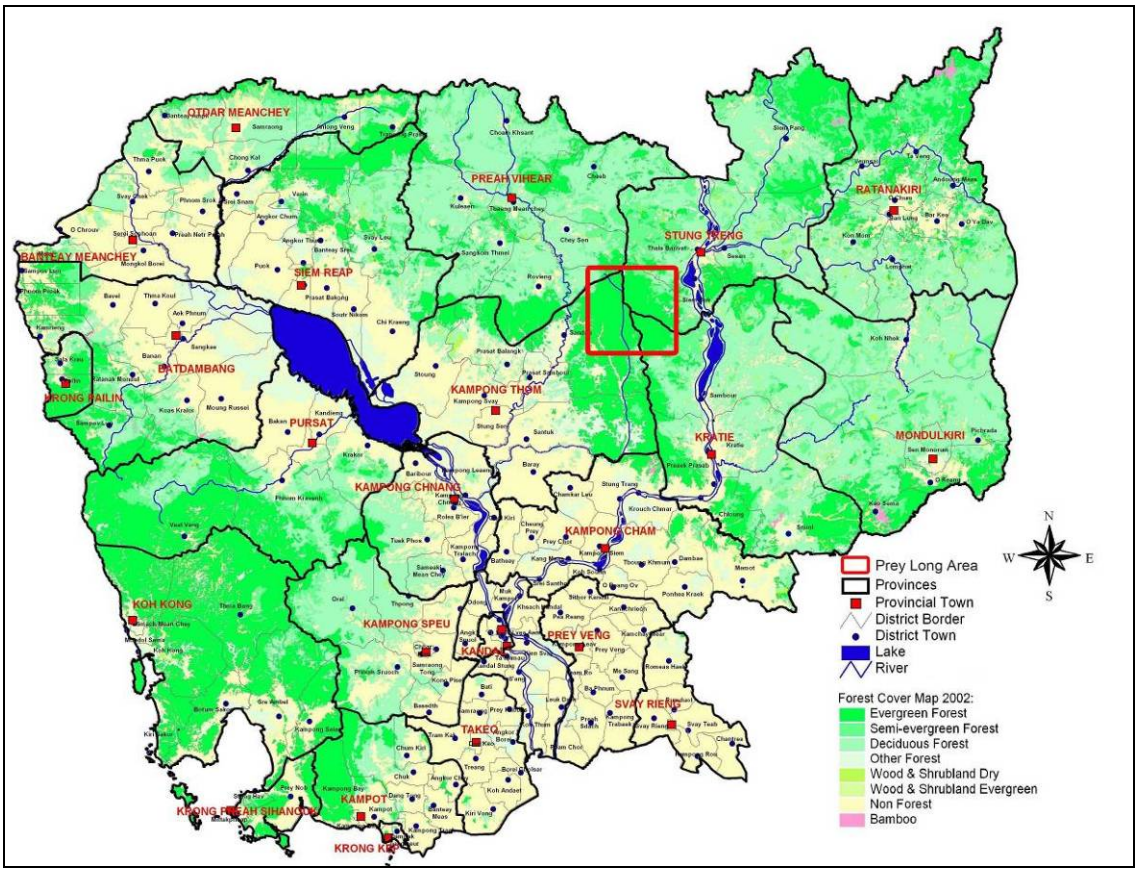

Fig. 2. The Prey Long region demarcated on a map of Forest Cover of Cambodia (2002).

Concessions

Prey Long is under the jurisdiction of the Forestry Administration (FA) and forms part of the forest estate governed by the Forest Law under which it is classified as state private land. Three logging concessions are located in Prey Long belonging to Pheapimex Fuchan, Everbright CIG Wood Co. Ltd., and Colexim Forest Concession. The Everbright concession is located in Kratie and Steung Treng Provinces and covers an area of 136,376 ha. The Colexim concession is located in the western part of Prey Long in Kampong Thom Province and covers 139,610 ha. Cambodia's significant reserves of high-value forests present an important economic resource, the sustainable use of which would be of considerable benefit to the country and contribute to national development. However, the recent history of Cambodian forestry has been turbulent. Following a period of anarchic logging, the concession system has been suspended since 2001.

Local Communities

More than 250,000 people live in 340 villages in and around Prey Long most of whom belong to the indigenous group called Kuy. The forest is an intricate part of their culture and spiritual life and they depend on it for their survival. Local villagers collect resin, building materials, medicine, and food from the forest. More than 700.000 people live within 10 kilometers from the forest, many of whom depend upon the natural resources of the forest for their livelihoods. Much of Prey Long is found on infertile soil with little value for cultivation. However, Prey Long is an important spawning area for fish. Conservation of the Prey Long forest will benefit the indigenous communities living in the vicinity of the forest as well as well as farmers and fishermen relying on the downstream water resources of the Mekong River.


Fig. 3. A few villages, here village Spong, occur in the inner Prey Long. The communities are relatively self sufficient and are isolated for long periods of the year when heavy rain makes access by road very difficult.

Watershed

Prey Long is a primary watershed, regulating water and sediment flow to the Mekong River and the Tonle Sap Lake. Large parts of Cambodia and southern Vietnam lie within the Mekong River watershed area, an area that makes up some of the richest agricultural areas, and most densely populated, of the region. As such, Prey Long is vital to Cambodia's and the regions' long-term environmental sustainability and its people's food and water security, which in turn may be a precondition for political stability in the region. Global warming and the predicted increase in extreme weather events may affect both frequency and severity of future events of flooding.

Fig. 4. Prey Long is part of the greater Mekong watershed area. Forest destruction can disturb regional weather patterns and have serious implication for water flows of rivers and cause flooding during rainy seasons and drought during dry season. In addition disturbance of forests vegetation causes soil erosion with consequent siltation of rivers which in turn affect production in aquatic ecosystems. Several million people live within the Mekong watershed area in Cambodia and Vietnam. Flooding is already experienced in Phnom Penh and other towns and cities along the Mekong during the rainy season.

PREY LONG – A MOSAIC OF DIFFERENT FOREST TYPES

Recent botanical surveys have revealed a diverse and unique floral composition within Prey Long forest complex. Prey Long is made up of at least seven distinct forest types (Box 1). The seven forest types can be classified into the broader definitions of evergreen, semi-evergreen, or deciduous forests, but they differ significantly from each other on the basis of species composition, dominant trees, and plant community structure.

Box 1. Forest Types of Prey Long

1. Deciduous Forest. This type of forest is similar to the dry seasonal forest found in dryer climates Indochina. Trees are relatively short (3-12 m). Mainly drought tolerant species with small leaves and thick barks. Dry deciduous forests form a transition to natural grassland, which are found on the very dry sandy sites.
2. Evergreen short forest. The forest is a transition type to tall evergreen forest, and often with similar species composition, yet trees are significantly smaller.
3. 'Sralao' (*Lagerstroemia*) forest. *Lagerstroemia* stands are distinct by their white bark and high, erect, fluted stems. They often dominate patches of forests.
4. Short riparian forest. This forest type occurs near rivers and streams, periodic inundated and remaining moist during the dry season.
5. Deciduous swamp forest. A quite unique forest type occurring around Pes Lake in the northern part of Prey Long. Several unique species and growth forms, normally associated with mangrove forest are found in this swamp forest.
6. Tall evergreen dipterocarp forest. This forest type is found on the moist but not waterlogged areas. The forest consists of a large diversity of species with canopy closure at 30-50 m.
7. Evergreen swamp forest. This forest type occurs on wet sites with permanent or long term inundation. The forest type is rare and endemic to Cambodia.

From McDonald (2004) and Theilade (2008).

In addition to the lowland evergreen forest, which is recognised as threatened globally, Prey Long is the last remaining area where forest types from deciduous to evergreen forests as well as the transition zones between them are found in a continuous and intact landscape. Conservation would provide future generations of Cambodians a chance to study the country's most productive forests and landscapes and the natural processes of succession and forest dynamics essential to develop sound forest management practices within the country (McDonald 2004). Some of the forest types are illustrated in figure 5-9.

Fig. 5. The dry deciduous forest is relatively open, trees are not more than 10-20 meter tall and diameter rarely more than 20 cm. However, the forest type contain some of the extremely valuable tree species such as *Dalbergia*, *Xylia* and *Pterocarpus*. Right: On poor shallow, rocky soil the dry deciduous forest is dominated by *Dipterocarpus tuberculatus* and the ground vegetation of Cycas

Fig. 6. Evergreen short forest. This type is a transition forest to the tall evergreen forest, and it dominates on more moist sites and where soil consists of sand mixed with clay.

Figure 7. *Lagerstroemia* (Sralao) is a forest type on mainly cold clay soil with high water holding capacity. It often forms more or less uniform stands. The species has strong wood but trunks are fluted, which restricts the use as a timber

Figure 8. Deciduous swamp forest occur at moist sites and is dominated by *Syzygium, Licuala, Calophyllum* and *Calamus*

Fig. 9. Primary evergreen Dipterocarp forest. Very large trees, some more than 1½ m in diameter and 60 meters tall, can be found in evergreen tall forest. Here *Anisoptera costata*.

THE EVERGREEN SWAMP FORESTS – A RARE AND ENDEMIC FOREST TYPE

The evergreen swamp forest of Prey Long is of particular importance for conservation as it is unique to Cambodia. This type of forest has most likely covered larger areas of the lowland plains in the past. It is now extremely rare as virtually all such areas have been converted for rice cultivation. The swamp forests are patches covering from a few to several hectares of permanently inundated forests. The largest of the identified swamp forests covers about 35 ha. It is dominated by hydrophytic trees (*Syzygium*, *Knema*, *Ficus*, and *Calophyllum*). Although these same genera also occur in upland forests, most are represented by different species in the swamp. Tall palms, *Livistona saribus.*, emerges from the canopy as indicator species of this vegetation type while dense stands of palms (*Calamus*, *Areca*, *Licuala*) and sporadic clusters of tree ferns dominate the understory. Pneumatophores, stilt roots, and aerial roots characterize the hydrophytes. Many of the tree species recorded in the evergreen swamp forest are endemic to this forest type.

In addition to its floristic uniqueness, the evergreen swamp forest is of importance to endangered wildlife such as elephant, Malayan sun bear, gaur, and banteng. The critically

endangered Siamese crocodile is reported from one of the swamps. Wildlife is attracted to the swamps, especially during the dry season when water is scarce.

Fig. 10. Wet evergreen swamp forest is dominated by palms, rattans and smaller size timber trees . Stilt roots and air-roots (pneumatophores) are adaptations to long tern inundation, which are rarely found outside mangrove ecosystems. Swamp forest represents a relict forest type supposedly common in lowland Cambodia before most of this forest types was converted for rice cultivation.

Fig 11. Wild pigs gather around open pond in Prey Long, caught by camera trap.

WILDLIFE OF PREY LONG

Greater Prey Long is considered to be particularly important as a wildlife habitat. It covers a large area of contiguous mixed forest habitats, which provides for a rich diversity of wildlife. Numerous streams and the seasonally inundated forest patches create open areas in-between the denser forest area which favours a variety of wildlife. Several species of globally threatened large mammals are found here, such as the Asian elephant *(Elephas maximus)***,** clouded leopard *(Neofelis nebulosa)*, marbled cat *(Pardofelis marmorata),* Malayan sun bear (*Helarctos malayanus),* banteng *(Bos javanicus),* gaur *(Bos gaurus),* sambar deer (*Rusa unicolor),* wild dog

(Cuon alpinus), sunda pangolin*(manis javanica)*, pileated gibbon (*Hylobates pileatus)*, pig-tailed macaque *(Macaca memestrina)*, and smooth-coated otter (*Lutrogale perspicillata*), (Olsson and Emmett 2007). Tiger (*Panthera tigris*) has been seen in the area as late as 2006 according to local guides.

Most large mammals are found at relative low densities, suggesting the high level of hunting pressure in the area. With improved management and protection, mammal populations is likely to increase and become significant within Cambodia and the region.

Fig. 12. Camera trap photo of banteng (wild cattle), Prey Long

Fig. 13. Camera trap photo of Malayan sun bear, Prey Long.

Fig. 14. Camera trap photo of smooth-coated otters, Prey Long.

Fig. 15. Camera trap photo of woolly-necked storks, Prey Long.

Prey Long is rich in turtles and tortoises such as the elongated tortoise *(Indotestudo elongata)*, Asian box turtle *(Cuora amboinensis)*, Asian leaf turtle *(Cyclemys oldhamii)*, giant Asian pond turtle *(Heosemys grandis)*, yellowed- headed temple turtle *(Heosemys annandalii)*, Malayan snail eating turtle *(Malayemys subtrijuga)*, black marsh turtle *(Siebenrockiella crassicollis)* and Asiatic softshell turtle *(Amyda cartilaginea)*. The very rare, critically endangered Siamese crocodile (*Crocodylus siamensis*) has also been recorded from this area.

In addition Prey long is home for a rich and diverse fauna of smaller animals like reptiles, amphibians, insects etc.

Fig. 16. Prey Long contain a wide variety of reptiles such as lizards, monitors, leguans and snakes. Left is a water dragon, centre a red tailed pit viper and right a Malayan pit viper.

Fig. 17 Prey Long is 'a heaven' to amphibians, in particular frogs. Amphibians are, compared to many other smaller animals, a relatively sparsely studied group. The likelihood of finding new species is, accordingly, high.

PAST AND PRESENT FOREST ENCROACHMENT AND DEGRADATION

The lowland rain forest of Cambodia contains a vast amount of economically exploitable timber, which has been one of the major resources for generating foreign income for development as well as for direct use in the Cambodian industries and rural communities. Native forests have given space for necessary agricultural food production and high productive plantations. However, the loss of natural forests and growing concerns of massive negative effects on biodiversity and watersheds led to suspension of all logging concessions in 2001 followed by a moratorium on logging in 2002. This stemmed the immediate threat by large-scale commercial logging in Prey Long. However, local and probably largely illegal activities still contributes to degrade the forest and its wildlife.

1. Illegal logging

Despite the official logging moratorium, there is widespread evidence of small-scale logging in Prey Long. Piles of sawn wood of luxury woods such as *Afzelia* are encountered in the forest and in villages. There is a steady stream of wood-loaded ox-charts leaving from the forest. Though a seemingly small activity, illegal logging is implicitly difficult to control, and often tends to escalate, as long as there is a demand and market for wood. Illegal logging in Prey Long target mainly luxury woods such as *Afzelia* and *Dalbergia*. These species are already locally extinct in many areas. The continued fragmentation of the dwindling populations may affect regeneration and long-term survival of these highly valuable species in Prey Long. In addition, frequent opening of the canopy layer tends to create very dense ground vegetation, which creates an inhospitable environment for larger ground living animals such as bears and elephants.

Figure 18. Logging took place up to 2002, where a moratorium put an end to official logging. Patches of the Cambodian rain forest contain large diameter trunks with high commercial value. These picture were taken in 2001.

Illegal logging.

Fig. 19. Low intensity, yet continuous selective cutting is still taking place. Trees are cut into planks in the forest and the planks are transported out by oxcarts.

2. Agricultural encroachment

Cambodia is experiencing a very rapid population increase and agricultural land is currently in need. Population increase has taken place both in the rural villages in or near Prey Long and villages and towns around. Opening of forests with logging roads and tracks, and improved roads to remote villages have made access to previous closed forest easier. Hence, there is both an internal expansion of agricultural area from the villages and an encroachment from the periphery and along the roads. Agricultural practice on newly opened sites is most often shifting cultivation. New fields may give a good return for a few years, but the soil is easily exhausted. Insecure land tenure and shortage of agricultural inputs as well as knowledge of more sustainable farming methods tend to create a continuous degradation and encroachment of the forest.

Fig.20. Agricultural encroachment usually starts with shifting cultivation, where trees are cut and burnt, and where the wood ash is the nutritious substrate for crop growing. In shifting cultivation the land is abandoned after some years of cultivation. However, most cleared forest nowadays become permanent fields and will not revert back to forest.

3. Hunting and wildlife collection

Villagers have always hunted during time of less agricultural production and as a supplement to agricultural production. Many middle age Cambodians have involuntarily lived in the forest during the trouble years. There is thus a tradition for bush meat. Traditional Indo-Chinese and Chinese medicine use many remedies from wild plants and animals. Strong commercial links to China has provided a huge market for such products, which in turn has put a strong pressure on native wildlife in Indo-china. Unfortunately many demanded products originate from endangered species. And as prices tend to increase with limited supply, the pressure on particular species can be self perpetuating.

Fig. 21. Hunting deers was common practice during the time old army guns were common in the countryside. Presumable collection and banning of guns have reduced poaching. However, the population of large wildlife is, after many years of uncontrolled hunting with former ubiquitous military firearms, probably reduced to a minimum and far below the potential number, the area could support. Above: deers hunted by foresters in Stung Treng in 2000.

Fig. 22. While shot guns have been banned, local village hunters use snares for hunting. Snares are placed at animal paths and are used for both small animals and larger.

4. Collection of non-timber forest products

Other use of the forest includes collection of resin from dipterocarps, collection of honey, medical plants, rattan and small construction material. As many as 80% of the households within and in the vicinity of Prey Long are estimated to rely on resin collection for income generation (McDonald 2004). Collevtion of forest products does not pose immediate threats to forest or wildlife albeit there is a limit of how much can be sustainable collected. The activities may be continued in a sustainable manner also after implementation of various forest conservation measures.

Fig. 23. Most dipterocarps contain valuable resin. The resin will collect in the small cut-out cave at the base of the stem. Burning promote resin exuding from the damaged part (left). Resin is one of the commercial forest products that can be collected from the forest and sold on the market. Resin buyers send trucks to the villagers to collect bags of resin (below)

Fig. 24. Forest honey collected from bee nests in forest trees. Honey collection gives a good income to local villagers. However, collection in its present form implies destruction of the nests

Fig. 25. Wild plant collection for medical purposes still has a wide use, despite availability of western' medicine. The *Zingiberaceae* is rich in traditional medicinal plants. Here *Curcuma sp*.

PREY LONG AND CLIMATE CHANGE, - LOCAL AND GLOBAL CONTEXTS

There are many inherent and ongoing challenges to sustainable forest management in Cambodia. The moratorium on logging, in effect since 2002, creates an opportune time for exploration of new approaches to sustainable and more equitable and socially responsible forest management. The Government of Cambodia has a desire to explore alternatives to the traditional forest concession management. Financing sustainable forestry through carbon credits is one of the potential future options. At recent high-level meetings, the Forestry Administration welcomed and encouraged the development of a pilot REDD demonstration project in the Prey Long region and the conversion of existing logging concessions for this purpose. A REDD proposal for Prey Long would be the first of its kind to address post-concession management. It would have to be closely aligned to existing and developing Cambodian policies on forest and climate change mitigation.

A REDD project for Prey Long would contribute to avoid further ecological and biological losses from the country's lowland evergreen forest and to conserve the unique evergreen swamp forests. It has the potential to provide socio-economic development to local communities and at the same time preserve a forest which is an integral part of their lives.

Fig. 26. Burning of forest and fossil fuels has caused large increase in the atmospheric CO_2 content. The most conspicuous and visual effect of the so-called greenhouse effect, global warning can be observed in arctic areas, where glaciers are melting at increasing speed (centre)

Next steps

While the underlying idea of REDD is simple, there are complex issues to be solved in order to implement an effective, efficient and equitable REDD project. These include the technicalities of carbon stock measurements, permanence, additionality, leakage, and reference levels. Apart from the monitoring, reporting and verification required in REDD projects, a number of issues well-known from protected area management are required. Some important next steps, in order for Prey Long to be protected under a REDD scheme, would include:

- **Identify stakeholders**

The Forest Administration under the Government of Cambodia has the mandate to manage Prey Long forest area. However, transition to and protection under a REDD project will involve a number of interest organisations outside FA. Stakeholders should cover key technical and policy areas involved in the implementation. It would include relevant institutions and NGOs with interest and experience within conservation and community development. The local Kuy communities, long term settlers as well as more recent immigrant communities in and around Prey Long must be involved in planning and decisions on future use of the forest area. A coordinating body with representation from different stakeholders could be a model for future management. Any future project should strive to obtain the standards set by Climate, Community & Biodiversity Alliance (CCBA).

- **Feasibility study: Estimate carbon stocks and deforestation rates**

Satellite images, aerial photographs and land use maps will be used to identify distribution of forest types. Images and photographs taken during the dry season may help to distinguish different forest types (evergreen/deciduous). Simple estimates on carbon content can be made from ground assessment of basal area and height of trees within established plots. IPCC default values to calculate above and below/ground biomass may be used to make assessments of total carbon. Soil samples from different forest types have been taken and are the process of being analysed. Forest cover change and deforestation rates will be calculated from existing forest cover maps 1997-2005. Deforestation rates in and around Prey Long will serve to calculate potential carbon credits under a REDD scheme. It will also direct efforts to slow encroachment and degradation. Scenarios for expected slowed deforestation rates will be modelled. A feasibility study is underway.

- **Boundary delineation**

The core area of Prey Long, which is largely covered by primary forests, covers an area of approximately 130,000 hectares (Annex 2). This area is proposed as a core zone to be protected from further deforestation and degradation. It is acknowledged that the suggested REDD project and sustainable development in surrounding secondary forests and around permanent settlements will include a thorough community consultation. Local communities use of forests should be mapped and taken into account in the delineation and regulations of potential REDD areas. The boundary around 130,000 ha is at least 150 km. It is envisaged that the REDD project area will include at least two main categories *viz.* a core protection forest and a buffer zone. The boundary delineation may be carried out partly under the National Forest Programme (GoC 2010).

- **Negotiate with concessionaires**

Prey Long is currently divided into three forest concessions, Pheapimex Fuchan, Everbright CIG Wood Co. Ltd., and Colexim Forest Concession. In order for concessionaires to forego future logging operations in the area some compensation scheme will have to be agreed upon. A model for 'buying out' concessionaires should be prepared.

- **Identify sensitive and key conservation areas**

Within the quite heterogeneous forest mosaic of Prey Long, some sites are envisaged to be particularly sensitive, either because they are very rare, or because they are subject to particular threats (the two factors usually coincide). Example of such areas could be swamp forest, riverine forest, high dipterocarp forest and particular stands of endangered species. Swamps and riverine forests are known to be particularly endangered by agricultural encroachment because they are easily converted into rice paddies. However, in addition to being botanically unique, the permanent moist areas are important as permanent water sources for wildlife during the dry season. Riverine forests are particularly important for watershed protection. Tall dipterocarp forest may be subject to illegal logging, and as this late succession forest has a scattered distribution, protection of viable stands are crucial for protection of the species. Particular stands of endangered tree species such as *Afzelia*, *Diospyros* or *Dalbergia* should be mapped and monitored.

Fig 27. Prey Long swamp forest and riverine forests are extremely important in a conservation context. Swamp forests are unique and probably the only reminiscent of this forest type in Indochina. Riverine forest form important wet corridors, which are important for migration and dispersal. Both swamps and rivers are permanent water areas for wildlife

- **Revision and / or verification of forest types**

The present classification of 7 forest types as referred to in section 2 is based on preliminary surveys by McDonald (2004) and Theilade et al. (2008), which in turn refer to categories described by Maurand 1943. However, the classifications need a thorough revision with inventories of species, abundance and soil description. This will involve botanical surveys employing qualitative and quantitative methods such as transects and collection of botanical specimens.

- **Mapping and classification of forest and land use**

Satellite images, aerial photographs and statistics give overall information about human population, villages, roads and rivers, main forest types, and topography. The latest land use map of the area is from 2004 (JICA 2004) and includes main land uses and vegetation types.

- **Ensure local community benefit and minimise negative impact**

Several villages are situated within the greater Prey Long. These villages will remain but inevitably be subject to some restriction on expansion and land use. Villagers should be compensated for restrictions on activities and furthermore benefit from the conservation measures, which implies that substantial input be given to support and improve their livelihood and alternative income. Inputs to agriculture and in particular agroforestry systems that could compensate for the inevitable restrictions on unsustainable use of forests. At present some of the villages are more or less isolated during the rainy season because of poor road accessibility. Improved infrastructure (roads) would ease both market and cultural exchange. Some communities may be able to benefit from incoming visitors in a type of ecotourism. Albeit probably limited in terms of monetary input, such activities can have a large symbolic value of environmental awareness rising.

Fig 28. People living within and around Prey Long use the forest and are dependent on it. Any conservation measure will inevitably affect them. It may be restrictive but could also create new opportunities. Whatever management regulation that may be implemented it is important that it is done in agreement with those living closest to the forest i.e. villagers within and around Prey Long.

- **Ensure biodiversity conservation**

Protection of Prey Long implies activities which will in itself help ensuring conservation of biodiversity. However, special types of flora and fauna may need to be addressed by special conservation strategies. This could be rehabilitation of habitats for bears and elephants, which in turn may require enrichment planting by particular species or creating ‘artificial’ sites for foraging. Faunal and botanical expertise should be included to identify particular conservation focal areas.

Fig 29. Prey Long is home to a variety of wildlife. Habitat destruction and hunting may threaten local species with extinction. Photo: local with common monitor lizard.

- **Develop a master plan for Prey Long**

The master plan should contain following key elements:

1. Mapping and classification of land use on landscape level
2. Legislative framework
3. Community development
4. Mangement plan and implementation
5. Funding

The management plan will include two main categories *viz*. the protected forest, which should remain tree covered, and the boundary / buffer zone, which may typically consist of forest user zones and agricultural land. In the protected forest, the aim is to maintain the forest cover. This would ensure environmental services such as watershed protection, biodiversity conservation, forest products, and regulation of local rains, apart from generating carbon credits. The forest user zones or buffer zone should, as far as possible, have a certain tree cover. This may be achieved by various types of agroforestry models, fruit trees or plantation crops. Involved communities and households should be closely involved in development of sustainable and productive methods for agriculture in the buffer zone and sustainable use of the forest.

- **Create funds distribution structure within Cambodia**.

On the long term, a REDD project is projected to generate funds in terms of carbon credits. However, substantial investments are needed for credits to be verified and marketed. Funding for calculation of baselines, verification and marketing of credits has to be raised. Likewise, a fund probably should be established to be responsible for a transparent and equitable distribution of funds.

- **Research**

Several of above activities contain high levels of uncertainties, which should be addressed through research activities. Cooperative research programmes between Cambodian and overseas

universities are assumed to be of interest for all partners. Research may encompass both student level (B.Sc., M.Sc. and Ph.D.) and post-graduates. Some evident research areas are:

1. Botanical and zoological research (systematics, ecology etc.)
2. Agricultural development including agroforestry
3. Community development including community forestry

With strong political will and commitment from all partners, it is our hope and ambition that a REDD scheme for sustainable management of Prey Long can be put in place for the benefit of the climate, for biodiversity and for the people of Cambodia.

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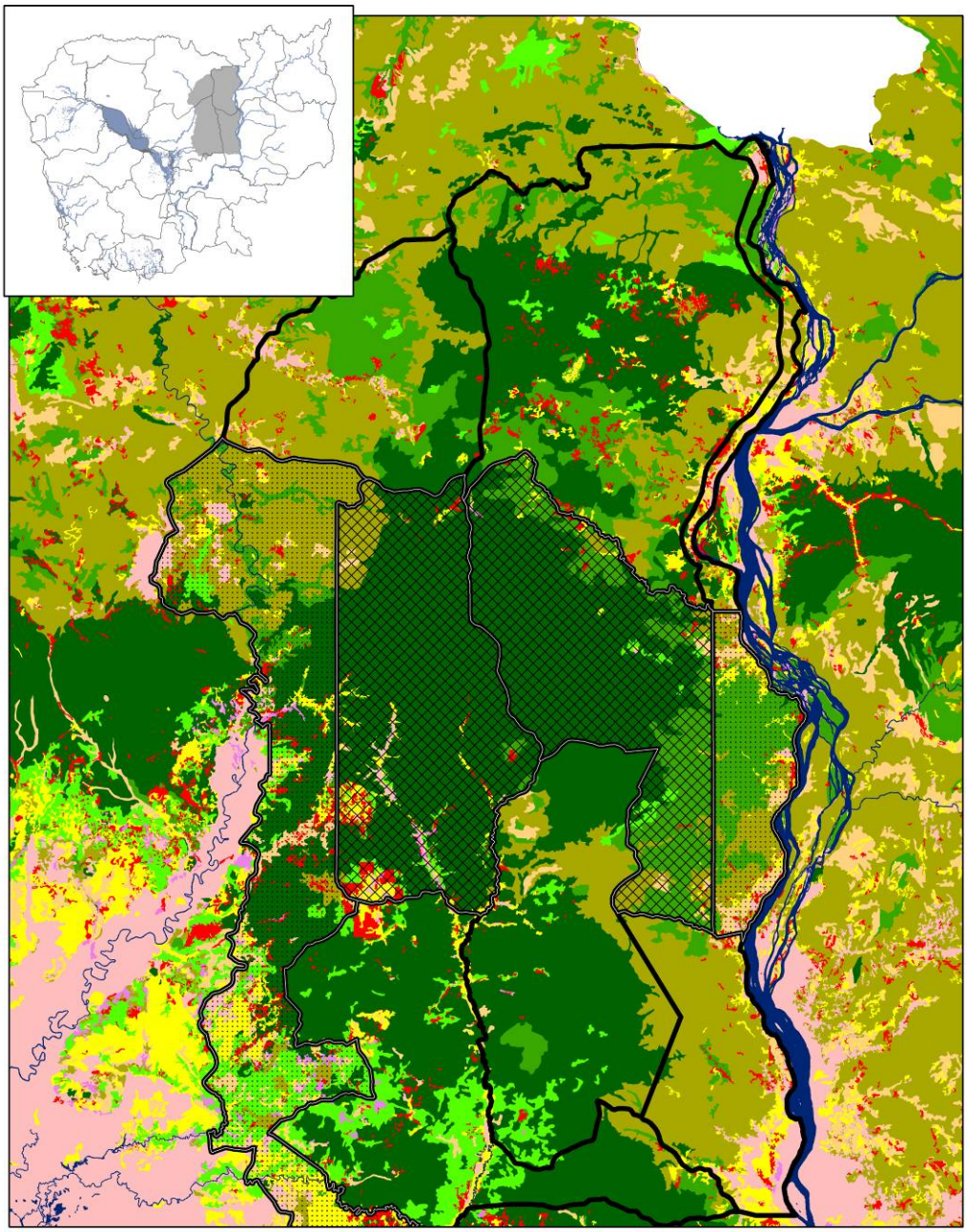
Appendix 1. Key Biodiversity areas in Indochina from Ecosystem Profile (Birdlife International 2005). Prey Long is situated in the Central Cambodian Lowlands (7) and harbours threatened lowland evergreen forest and swamps. So far this biome has not been granted any kind of protection.

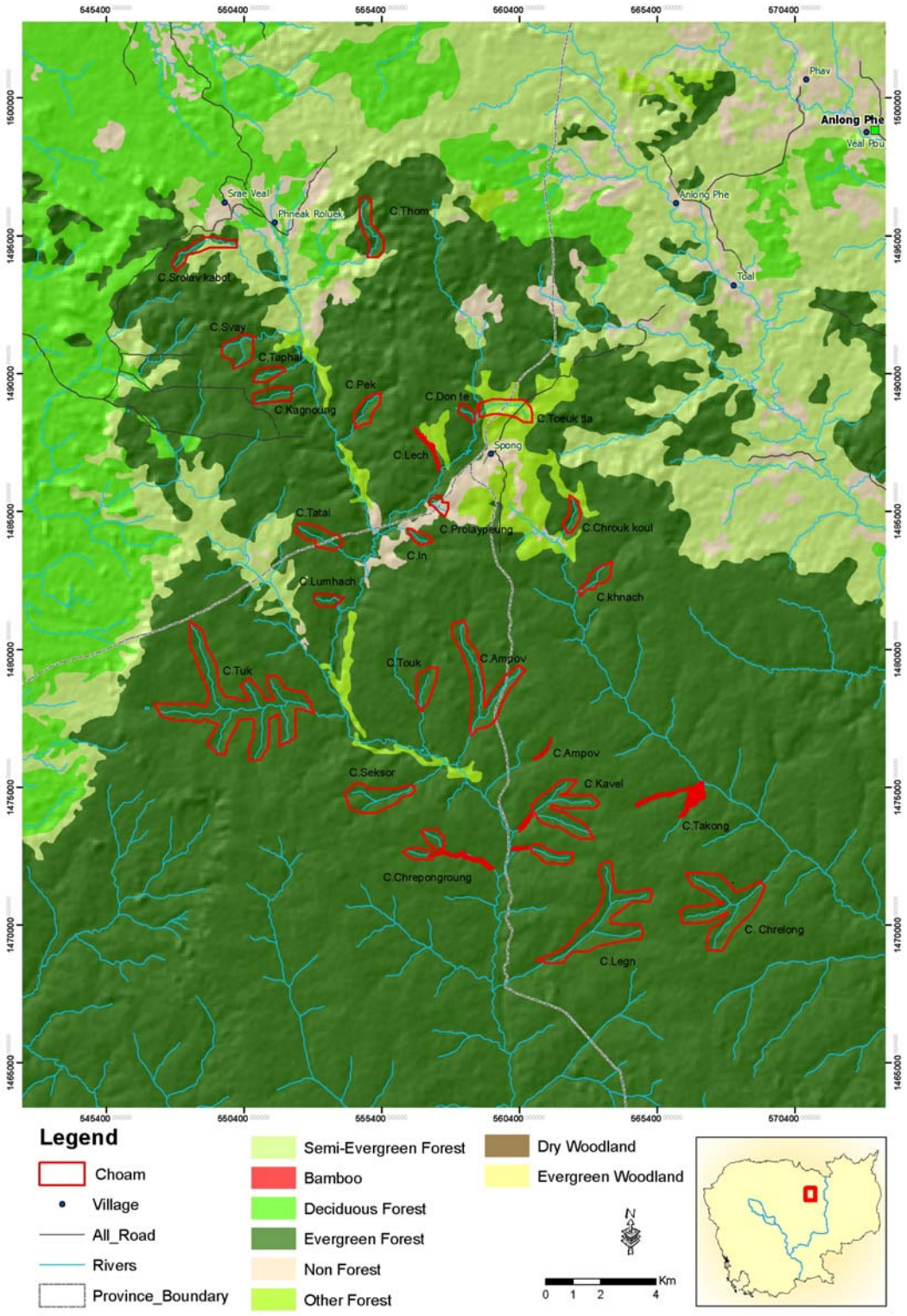
Roster of Key Biodiversity Areas

1 Ang Tropeang Thmor
2 Bassac Marsh
3 Basset Marsh
4 Boeung Chhmar / Moat Khla
5 Boeung Prek Lapouv
6 Boeung Veal Samnap
7 Central Cambodia Lowlands
8 Central Cardamoms
9 Chhep
10 Chhnuk Tru
11 Dei Roneat
12 Kampong Trach
13 Kirirom
14 Koh Kapik
15 Koh Rong Archipelago
16 Koh Tang Archipelago
17 Lomphat
18 Lower Stung Sen
19 Mekong River from Kratie to Laos
20 Mondulkiri / Kratie Lowlands
21 Northern Santuk
22 O Skach
23 Phnom Aural
24 Phnom Bokor
25 Phnom Samkos
26 Preah Net Preah / Kra Lanh / Pourk
27 Prek Taek Sap
28 Prek Toal
30 Sesan River
31 Snoul / Keo Sema / O Reang
32 Sre Ambel
33 Stung / Chi Kreng / Kampong Svay
34 Stung / Prasat Balang
35 Stung Kampong Smach
36 Stung Sen / Santuk / Baray
37 Upper Srepok Catchment
38 Upper Stung Sen Catchment
39 Veal Srongae
40 Virachey
41 Western Siem Pang

Appendix 2. Proposed Conservation core zone of Prey Long covering two forest concessions is shown as hatched area. It covers 283,000 ha. The area is estimated to be able to generate 1-5 million USD/year in REDD payments. Mekong River to the left.
Dark green areas: evergreen lowland forest. Lighter green: mixed deciduous forest. Brownish: deciduous forests. Red areas: Cleared within past 10 years.



Appendix 3. Map of proposed core zone to the south of Spong village. Swamp forest areas according to local guides are shown in red. No villages are located within the core zone but an estimated 250.000 persons live in villages bordering Prey Long. The majority belongs to the indigenous group called the Kuys. Prey Long is a primary watershed upon which an estimated 700.000 thousand people depend for irrigation. The swamp forests of Prey Long plays a significant role in regulating water and sediments flowing into Tonle Sap and Mekong River.



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WORKING PAPERS FOREST & LANDSCAPE 50 / 2010

Conservation of Prey Long Forest Complex, Cambodia

This project started in 2007 with a joint field expedition by Forest Administration, Forest and Landscape Denmark and Conservation International, Cambodia. Three botanical surveys have been conducted in the northern part of Prey Long with focus on the rare swamp forests with the objective to characterize the swamp forests and assess their conservation status.

This document contains a summary of the findings and we hope to draw attention to one of the last intact lowland rainforests of Indochina and the urgent need to develop a strategy for its continued protection, provision of environmental services and sustainable management.

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